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2 CLAIMS
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4 1. A surgical instrument for insertion into a body, the surgical instrument
5 comprising:

6 an elongated member comprising a distal portion adapted to engage
7 tissue in the body and a proximal portion capable of being manipulated by a user, wherein
8 said elongated member can be moved by said user in a degree of freedom;

9 a sensor positioned to detect position or motion of the elongated
10 member, or a portion thereof, in said degree of freedom of the elongated member;

11 an actuator engageable with the elongated member to apply a force
12 thereto; and

13 a controller in communication with the sensor and the actuator, the
14 controller adapted to control the application of the force, wherein the force is applied to the
15 elongated member as a haptic indication to the user when the elongated member has been
16 moved a predetermined distance or to a predetermined position by the user in the degree of
17 freedom.
18

19 2. A surgical instrument according to claim 1 wherein the degree of freedom
20 is a translational degree of freedom.
21

22 3. A surgical instrument according to claim 1 wherein the degree of freedom
23 is a rotational degree of freedom.
24

25 4. A surgical instrument according to claim 1 wherein the haptic indication
26 includes at least one of a detent force, a vibration, a barrier force, a damping force, and a
27 spring force.
28

1 5. A surgical instrument according to claim 1 wherein the haptic indication is
2 output to the user when the distal portion of the elongated member has been translated to an
3 end of a working channel that guides said elongated member.
4

5 6. A surgical instrument according to claim 1 wherein said haptic indication is
6 output to the user each time the elongated member additionally moves the predetermined
7 distance.
8

9 7. A surgical instrument according to claim 1 wherein the elongated member
10 includes one or more of a guidewire, a catheter, a heart pacing lead, and a stylet.
11

12 8. A surgical instrument according to claim 1 wherein the distal portion of the
13 elongated member includes one or more of a blade, a serrated edge, a biopsy tool, a trocar tip,
14 an ultrasonic tool, a needle, a vibrating tip, a suturing tool, a retractor, an electrosurgical
15 cutter, an electrosurgical coagulator, a forceps, a needle holder, scissors, an irrigator, an
16 aspirator, a medicator, a laser tool, a cryogenic tool, a flexible steering or guiding tip, and a
17 camera.
18

19 9. A surgical instrument for insertion into a body, the surgical instrument
20 comprising:

21 an elongated member comprising a distal portion adapted to engage
22 tissue in the body and a proximal portion capable of being manipulated by a user in a degree
23 of freedom;

24 a sensor positioned to detect a first force applied to the elongated
25 member by the user in the degree of freedom;

26 an actuator engageable with the elongated member to apply a second
27 force thereto in the degree of freedom; and

28 a controller in communication with the sensor and the actuator, the
29 controller adapted to control the application of the second force in relation to the first force
30 detected by the sensor.
31

1 10. A surgical instrument according to claim 9 wherein the degree of freedom
2 is translational.

3
4 11. A surgical instrument according to claim 9 wherein the degree of freedom
5 is rotational.

6
7 12. A surgical instrument according to claim 9 wherein the controller is
8 programmable.

9
10 13. A surgical instrument according to claim 10 wherein the magnitude of
11 the second force is from about 10 percent to about 90 percent of the first force detected by the
12 sensor.

13
14 14. A surgical instrument according to claim 13 wherein the second force
15 is applied in a direction opposing insertion of the elongated member.

16
17 15. A surgical instrument according to claim 10 further comprising an
18 outer member comprising an orifice into which the elongated member is insertable and
19 wherein the actuator is housed within the orifice.

20
21 16. A surgical instrument according to claim 15 wherein the outer member
22 is an endoscope and wherein the orifice is a working channel of the endoscope.

23
24 17. A surgical instrument according to claim 15 wherein the outer member
25 is an introducer sheath and wherein the elongated member is an endovascular instrument.

26
27 18. A surgical instrument according to claim 17 wherein the endovascular
28 instrument comprises one or more of a guidewire, a catheter, a heart pacing lead, and a stylet.

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TOTAL: 8572800

1 19. A surgical instrument according to claim 10 wherein the actuator is
2 capable of applying the second force so that the second force is additive to the first force
3 applied to the elongated member by the user.
4

5 20. A surgical instrument according to claim 9 wherein the actuator is
6 capable of applying the second force so that the second force reduces the first force applied to
7 the elongated member by the user.
8

9 21. A surgical instrument according to claim 9 further comprising a sensor
10 coupled to the actuator to detect the second force.
11

12 22. A surgical instrument according to claim 10 further comprising a
13 position detector coupled to the elongated member to detect a relative insertion position of the
14 elongated member.
15

16 23. A surgical instrument according to claim 9 wherein the distal portion
17 comprises one or more of a blade, a serrated edge, a biopsy tool, a trocar tip, an ultrasonic
18 tool, a needle, a vibrating tip, a suturing tool, a retractor, an electrosurgical cutter, an
19 electrosurgical coagulator, a forceps, a needle holder, scissors, an irrigator, an aspirator, a
20 medicator, a laser tool, a cryogenic tool, a flexible steering or guiding tip, and a camera.
21

22 24. A surgical instrument according claim 10 further comprising a sensor
23 positioned to detect a rotational force being applied to the elongated member by the user and
24 a second actuator engageable with the elongated member to apply a rotational force thereto.
25

26 25. A surgical instrument according to claim 11 wherein the second force
27 is a rotational force.
28

29 26. An endoscopic assembly comprising:
30 an endoscope comprising an orifice;
31 an actuator within the orifice;

1 an elongated member insertable into the orifice; and
2 a sensor positioned to detect a force being applied to the elongated
3 member.
4

5 27. An endoscopic assembly according to claim 26 further comprising a
6 controller in communication with the actuator and the sensor.
7

8 28. An endoscopic assembly according to claim 27 wherein the actuator is
9 adapted to apply a force to the elongated member and wherein the controller is adapted to
10 control the force applied to the elongated member in relation to the force detected by the
11 sensor.
12

13 29. An endoscopic assembly according to claim 27 wherein the controller
14 is at least partially within the orifice.
15

16 30. An endoscopic assembly according to claim 26 wherein the sensor is
17 positioned to detect a longitudinally directed force applied to the elongated member by a user.
18

19 31. A method of inserting a surgical instrument into an insertion site in or
20 on a body, the method comprising:
21 inserting the surgical instrument into an orifice;
22 applying a user force to a portion of the surgical instrument to force the
23 instrument in an insertion direction; and
24 applying a second force to the instrument from within the orifice.
25

26 32. A method according to claim 31 further comprising sensing the user
27 force.
28

29 33. A method according to claim 32 wherein the second force is related to
30 the user force.
31

1 34. A method according to claim 31 wherein the second force is in the
2 insertion direction.

3
4 35. A method according to claim 31 wherein the second force is in a
5 direction opposite to the insertion direction.

6
7 36. A method according to claim 31 wherein the second force is applied by
8 an electromechanical actuator.

9
10 37. A method according to claim 31 further comprising:
11 detecting a position of the surgical instrument in a working channel
12 extending from the orifice, the surgical instrument being sensed in the working channel using
13 a sensor device, wherein the second force is applied to a portion of the surgical instrument
14 using an actuator to move the instrument through the working channel, wherein the surgical
15 instrument is moved to a position so that a leading end of the surgical instrument is located at
16 a predetermined distance relative to an end of the working channel.